Individual Profiling through ridges and pores of fingerprints : Microscopic study on the variations of homeostasis and ambience among the Cross Sectional Young adult & Criminal Records

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Abstract- Forensic science is the application of various scientific fields in aiding criminal justice system. Fingerprint is the most reliable biometric feature and even after 140 years it remains as a robust method for individual identification. There have been quite a number of studies in the field of fingerprint patterns but few pertain to the field of ridgeology and poroscopy. In this study samples were obtained from normal individuals as well as from convicted criminals, both belonging to the Gujarati community and a correlative study were carried in order to provide a possible significant difference between both the communities with respect to variations in homeostasis. Statistical analysis were performed to provided a significant result.
Keywords – Fingerprint, Ridgeology, Poroscopy, Microscope.

I. INTRODUCTION

Forensic science is one of the most integral part of criminal justice system and fingerprint is among the core component of it as far as biometrics are concerned. Fingerprints are the most conventional method being an undisputed form of biometric method for individual identification. It is not only useful in criminal identification but also in cases of civil claims and other routine identification of individuals in various walks of life. Fingerprints are the unique patterns made by the papillary ridges on the distal ends of phalanges and thumb. The uniqueness and permanency affords an infallible means for personal identification. The fingerprints possesses different features that leads to identification of individuals and they are – overall patterns, ridge orientation and dimensions and pore localizations.

The work concerned here is basically concentrated on ridgeology and poroscpoy. Ridgeology is an evaluating method of friction ridges. It refers to the forensic identification science that is associated with all the ridges of volar areas. Poroscopy is a method of personal identification through the comparison of impressions of sweat pores (present on friction ridges). The method was discovered and developed by Edmund Locard in 1912. Locard observed that like the ridge the pores are also permanent, immutable and individual, and these are useful to establish the identity or otherwise of individuals when available ridges do not provide sufficient ridge characteristics. The study conducted here basically is bound to the criminals and student populations of Gujarat. The minute details in context of ridges in the students and also in criminal population pertaining to Gujarat were analyzed to establish the correlation between the dimensions of the ridges of both the class of samples. The correlation of pores were also studied between the said samples in order to determine if there occurs any significant between them. Certain psychological situations were also created to provide some stimuli of stress to the normal individuals to identify if differential mental state created any kind of difference as far as ridgeology and poroscopy are concerned.

II. MATERIAL AND METHOD

Ink-less Pad, Fingerprint Slip, Magnifying Glass, Hand-held digital microscope (Dino-Lite), Infra-Red Stereomicroscope (Dissecting Microscope) and Layer Voice Analysis (LVA).
Ten digit fingerprint samples of 10 students (considered to be normal individuals) from Gujarati community were collected alongwith their voice samples to correlate the psychological condition of the students with that of

fingerprint study. For the study of ridge dimensions and pores ten-digit rolled fingerprints of students belonging to Gujarati community were taken in fingerprint sheets using ink-less pads in two different sections, one before voice samples and another after it. For each finger six readings were taken from three different regions nearer to the core area (vertical above the core area and two horizontal, one right and another left from the core area), two from each region. In case of Layer Voice Analysis, the instrument was calibrated with a baseline as reference. In this case, every subject has been instructed to get the prints recorded simultaneously before and after having the stressed psychological condition. Because of the psychological condition the individual has been allowed to record the prints with an assessment of relatively abnormal conditions. Here after the dimensions has been noted. The dimensions were noted with a dino-lite microscope with a uniform magnification as well as in stereomicroscope. The results have been found to be significant. Ten digit fingerprint samples of 30 criminals of Gujarati community were obtained from Directorate Forensic Science, Gandhinagar, Gujarat. All these has been subjected to statistical analysis. For poroscopy analysis three different readings were taken in left and right hand with stereomicroscope.

III. EXPERIMENT AND RESULT

Firstly analysis of the ridge widths were observed (ridges were counted from core) of both hands of criminals as well as of normal individuals. In addition to that, diameter of pores on those particular ridges (though randomly) were also observed and three readings per finger were taken.

Statistical Analysis

	hand	N	Mean	Std. Deviation	Std. Error Mean
criminal	1	279	.29968	.072550	.004343
	2	299	.30301	.072419	.004188
normal	1	279	.15850	.055413	.003318
	2	299	.16061	.077417	.004477

Table 1 Group Statistics for criminal and normal individuals

		Levene's Test for Equality of Variances		t-test for Equality of Means						95% Confidence Interval of the Difference	
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference		Lower	Upper
Criminal	Equal variances assumed	3.680	.056	-.552	576	.581	-.003329	.006033		-.015179	.008521
	Equal variances not assumed			-.552	573.098	.581	-.003329	.006034		-.015180	.008522
Normal	Equal variances assumed	.165	.685	-.375	576	.708	-.002110	.005635		-.013178	.008957
	Equal variances not assumed			-.379	540.433	.705	-.002110	.005572		-.013057	.008836

Table 2 Independent Samples test for criminals and normal individuals

	Hand	N	Mean	Std. Deviation	Std. Error Mean
person1	RIGHT	30	.2125	.09749	.01780
	LEFT	30	.1887	.07726	.01411
person2	RIGHT	30	.1651	.06617	.01208
	LEFT	30	.1736	.07847	.01433
person3	RIGHT	30	.1391	.03846	.00702
	LEFT	30	.1397	.02360	.00431
person4	RIGHT	30	.1674	.06557	.01197
	LEFT	30	.1763	.07520	.01373
person5	RIGHT	30	.1449	.02231	.00407
	LEFT	30	.1403	.01774	.00324
person6	RIGHT	30	.1483	.02424	.00443
	LEFT	30	.1436	.02122	.00387
person7	RIGHT	30	.1436	.02738	.00500
	LEFT	30	.1679	.13775	.02515
person8	RIGHT	30	.1500	.03660	.00668
	LEFT	30	.1724	.13812	.02522
person9	RIGHT	30	.1573	.04307	.00786
	LEFT	30	.1611	.02763	.00504
person10	RIGHT	30	.1455	.03415	.00623
	LEFT	30	.1599	.03034	.00554

Table 3 Group statistics of normal individuals

		N	Mean	Standard Deviation	Standard error mean
Person 1	1.00	15	0.2919	0.04063	0.01049
	2.00	14	0.3061	0.06133	0.01639
Person 2	1.00	15	0.3077	0.07268	0.01876
	2.00	14	0.3297	0.05632	0.01505
Person 3	1.00	15	0.3637	0.08878	0.02292
	2.00	14	0.3126	0.04715	0.01260
Person 4	1.00	15	0.3041	0.05823	0.01504
	2.00	14	0.3484	0.11880	0.03175
Person 5	1.00	15	0.3525	0.06867	0.01773
	2.00	14	0.2948	0.04039	0.01079
Person 6	1.00	15	0.3017	0.05230	0.01350
	2.00	14	0.3468	0.06557	0.01752
Person 7	1.00	15	0.3262	0.07979	0.02060
	2.00	14	0.3106	0.04952	0.01323
Person 8	1.00	15	0.3264	0.05439	0.01404
	2.00	14	0.2951	0.06003	0.01604
Person 9	1.00	15	0.3170	0.06219	0.01606
	2.00	14	0.3250	0.05923	0.01583
Person 10	1.00	15	0.2746	0.05176	0.01336
	2.00	14	0.3177	0.07034	0.01880
Person 11	1.00	15	0.2831	0.05289	0.01366
	2.00	14	0.3129	0.05486	0.01466
Person 12	1.00	15	0.3184	0.04360	0.01126
	2.00	14	0.3025	0.05867	0.01568
Person 13	1.00	15	0.2611	0.04820	0.01245
	2.00	14	0.3236	0.04968	0.01328
Person 14	1.00	15	0.2878	0.05505	0.01421
	2.00	14	0.3360	0.05779	0.01545
Person 15	1.00	15	0.2825	0.04076	0.01053
	2.00	14	0.2857	0.08498	0.02271
Person 16	1.00	15	0.2709	0.04646	0.01200
	2.00	14	0.2911	0.04984	0.01332
Person 17	1.00	15	0.2567	0.03140	0.00811
	2.00	14	0.2894	0.05206	0.01391
Person 18	1.00	15	0.2967	0.04826	0.01246
	2.00	14	0.4959	0.56217	0.15025
Person 19	1.00	15	0.2903	0.04930	0.01273
	2.00	14	0.3087	0.08499	0.02272
Person 20	1.00	15	0.2786	0.04526	0.01169
	2.00	14	0.3055	0.06791	0.01815
Person 21	1.00	15	0.2695	0.04765	0.01230
	2.00	14	0.2803	0.04869	0.01301
Person 22	1.00	15	0.2770	0.04844	0.01251
	2.00	14	0.2938	0.04972	0.01329
Person 23	1.00	15	0.2810	0.04243	0.01096
	2.00	14	0.2851	0.05025	0.01343
Person 24	1.00	15	0.3103	0.08293	0.02141
	2.00	14	0.2634	0.04752	0.01270
Person 25	1.00	15	0.3021	0.04775	0.01233
	2.00	14	0.2694	0.03543	0.00947
Person 26	1.00	15	0.3325	0.10481	0.02706
	2.00	14	0.2971	0.04864	0.01300
Person 27	1.00	15	0.4082	0.24667	0.06369
	2.00	14	0.3067	0.07341	0.01962

Person 28	1.00	15	0.2777	0.05836	0.01507
	2.00	14	0.3068	0.04232	0.01131
Person 29	1.00	15	0.2783	0.03385	0.00874
	2.00	14	0.3126	0.07897	0.02111
Person 30	1.00	15	0.3290	0.09190	0.02373
	2.00	14	0.3658	0.26176	0.06996

Table 4 Group Statistics of criminals

IV. CONCLUSION

Based on the analysis of pores and ridges the following conclusions could be deduced. Poroscopy studies were conducted in normal individuals which showed no significant variations in the pore structures. Criminal fingerprint samples were also analyzed for poroscopy which showed minute differences in pore structures between the left and right hand (hand of commission of crime). The analysis were done individually for criminals and normal people. Out of thirty criminals, eleven possessed significant difference between right and left ridge width values ($p<0.05$) and there were no significant differences between right and left ridge widths of normal people (all $p>0.05$). Thus it can be inferred that a possible correlation exists and a significant difference between the right and left ridge widths (of fingerprints) of the criminals also present. No significant difference was found to exist between the ridge widths of right and left fingers of the normal population were obtained. Furthermore, the significant differences noted in the ridge dimensions in case of criminals could possibly attribute to the palmar stress of the hand which was active/ involved for of commission of crime. This would be a probable indicator of the criminal identity in the narrowed down conditions. Still there may be certain limitations that those individuals who are also involved in the specific conditions of palmar stress with the physical activity.

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